

Claims

1. A method for processing data packets within a network element cluster having a plurality of network element nodes, said network element cluster having a cluster network address common to said plurality of nodes, said method comprising the steps of:
 - determining distribution decisions for first data packets, a first data packet being a data packet initiating opening of a packet data connection to said cluster network address, according to predetermined criteria,
 - selecting from said first data packets for each node of the network element cluster those first data packets, which are to be processed in said particular node, according to the distribution decisions,
 - maintaining node-specific lists about opened packet data connections for which a node is responsible, and
 - selecting from second data packets, a second data packet being a data packet relating to an opened packet data connection specified in a node-specific list, for each node of the network element cluster those second data packets, which relate to connections on the node-specific list of said particular node.
2. A method according to claim 1, wherein each node of the network element cluster receives all data packets directed to the cluster network address and selects which data packets are processed in that particular node, on the basis of the distribution decisions or on the basis of the node-specific list.
3. A method according to claim 1, said maintaining comprising the substeps of:
 - adding an entry representing a new packet data connection to the node-specific list of that node, in which a first data packet is selected to be processed, and
 - removing, after receiving in said network element cluster such a second data packet, which is further a data packet relating to closing of a packet data connection, an entry representing an opened packet data connection from a corresponding node-specific list.
4. A method according to claim 1, wherein said node-specific list comprises timing information for determining how long an opened packet data connection is valid, and said maintaining comprises the substeps of:
 - updating said timing information, when a node for processing a second data packet is selected,

- removing an entry representing an opened packet data connection from said node-specific list, when a predefined time period from the receiving of the latest data packet relating to said packet data connection is exceeded.
5. A method according to claim 4, comprising the step of:
- 5 - determining the status of an opened packet data connection, and wherein status information indicating the determined status of an opened packet data connection is maintained in said node-specific list.
6. A method according to claim 1, wherein said node-specific list comprises timing information for determining how long an opened packet data connection is valid, and said maintaining comprising the substeps of:
- 10 - adding an entry representing a new packet data connection to the node-specific list of that node, in which a first data packet is selected to be processed,
- updating said timing information, when a node for processing a second data packet is selected, and
- 15 - removing an entry representing an opened packet data connection from said node-specific list, when a predefined time period from the receiving of the latest data packet relating to said packet data connection is exceeded.
7. A method according to claim 6, comprising the step of:
- 20 - determining the status of an opened packet data connection, and wherein status information indicating the determined status of an opened packet data connection is maintained in said node-specific list.
8. A method according to claim 7, wherein a plurality of status indications are used and said predefined time periods are status indication specific.
- 25 9. A method according to claim 8, wherein at least three status indications are used, a first status indication corresponding to a packet data connection, for which so far only a first data packet is being detected, a second status indication corresponding to a packet data connection, for which additionally at least one further data packet is being detected, and a third status indication corresponding to a packet data connection, for which a packet data relating to closing of said packet data connection is being detected.
- 30 10. A method according to claim 9, wherein packet data connections are Transfer Control Protocol connections, the first data packet is a SYN packet, and the data

packet relating to the closing of a packet data connection is either a FIN packet or a RST packet.

11. A method according to claim 1, wherein for each node a node-specific list of opened packet data connections, for which the node is responsible, is maintained, said method further comprising the steps of:

- maintaining for each node a second node-specific list of opened packet data connections, for which other nodes of the network element cluster are responsible,
 - determining distribution decisions for third data packets, a third data packet being a data packet relating to said cluster network address but neither a data packet relating to an opened packet data connection on a node-specific list or on a second node-specific list nor a data packet initiating opening of a packet data connection, according to said predetermined criteria,
 - selecting from said third data packets for each node of the network element cluster those third data packets, which are to be processed in said particular node, according to the distribution decisions, and
 - updating for each node either the node-specific list or the second node-specific list when selecting to process a third data packet in a node of the network element cluster,
- and wherein
- for each node the second node-specific list is updated when selecting to process a first data packet in another node, and
 - for each node the second node-specific list is updated when selecting to process a second data packet in another node.

12. A method according to claim 11, wherein said node-specific lists and said second node-specific lists comprise timing information for determining how long an opened packet data connection is valid, and said maintaining the node-specific lists and second node-specific lists comprises the substeps of:

- adding an entry representing a new packet data connection to the node-specific list of that node, in which a first data packet is selected to be processed, and to the second node-specific lists of the other nodes,
- adding an entry representing the packet data connection to the node-specific list of that node, in which a third data packet is selected to be processed, and to the second node-specific lists of the other nodes,
- updating said timing information in the node-specific lists and second node-specific lists based on a selection of a node for processing a second data packet, and

19. A method according to claim 17, wherein said header fields comprise the source and destination address fields of Internet Protocol data packet header and the source and destination port fields of a User Datagram Protocol data packet header.

20. A method according to claim 17, further comprising the step of:

- 5 - updating the node-specific sets of hash values.

21. A method according to claim 1, further comprising the step of:

- updating said predetermined criteria.

22. A cluster of network element nodes, said cluster having a plurality of nodes and a cluster network address common to said plurality of nodes, said cluster further
10 comprising:

- means for receiving data packets relating to said cluster network address,
- means for determining distribution decisions for received first data packets, a first data packet being a data packet initiating opening of a packet data connection to said cluster network address, according to predetermined criteria,

- 15 - means for selecting from said first data packets for each node of the network element cluster those first data packets, which are to be processed in said particular node according to the distribution decisions,

- means for maintaining node-specific lists about opened packet data connections for which a node is responsible,

- 20 - means for selecting from received second data packets, a second data packet being a data packet relating to an opened packet data connection specified in a node-specific list, for each node of the network element cluster those second data packets, which relate to connections on the node-specific list of said particular node, and

- 25 - means for sending to each node of said network element cluster data packets selected for the particular node.

23. A cluster according to claim 22, further comprising means for updating said predetermined criteria.

24. A network element for constructing a cluster of network element nodes, said cluster having a plurality of network element nodes and a cluster network address
30 common to said plurality of network element nodes, said network element comprising:

- means for receiving data packets,
- means for determining distribution decisions for at least some of received data packets according to predetermined criteria,

- means for selecting, based on distribution decisions, from those received data packets, which are data packets initiating opening of packet data connection to said cluster network address, first data packets for processing in the network element,

5 - means for maintaining a list about opened packet data connections in the network element, and

- means for selecting, based on said list, from received data packets second data packets, a second data packet being a data packet relating to an opened connection on said list, for processing in the network element.

10 25. A network element according to claim 24, further comprising means for updating said predetermined criteria.

26. A network element according to claim 24, further comprising

- means for detecting such a second data packet, which is a data packet relating to closing of a packet data connection,

15 wherein said means for maintaining said list is arranged to

- add an entry representing an opened packet data connection to said list when a first data packet is selected for processing in the network element, and

- remove an entry from said list, when a second data packet relating to closing of a packet data connection is detected.

20 27. A network element according to claim 24, wherein entries of said list comprise timing information for determining how long the opened packet data connection is valid and said means for maintaining said list is arranged to

- add an entry representing an opened packet data connection to said list when a first data packet is selected for processing in the network element,

25 - update said timing information at least when a second data packet is selected, and

- remove an entry from said list, when a predefined time period from the arrival of the latest data packet relating to said entry is exceeded.

28. A network element according to claim 27, further comprising means (707) for determining the status of an opened packet data connection, wherein entries of said
30 list comprise status information and said means for maintaining said list is arranged to update said status information according to a determined status.

29. A network element according to claim 28, wherein said predefined time period is status specific.

30. A network element according to claim 24, further comprising

- means for detecting, based on distribution decisions according to predetermined criteria, from received data packets, which are data packets initiating opening of packet data connections, third data packets to be processed in at least a second network element,

5 - means for maintaining a second list about opened packet data connections in said at least second network element,

- means for detecting from received data packets fourth data packets, a fourth data packet being a data packet relating to an opened connection on said second list,

10 - means for selecting, based on distribution decisions, from received data packets fifth data packets, a fifth data packet being a data packet relating to said cluster network address but neither a data packet relating to a packet data connection on said list or on said second list nor a data packet initiating opening of a packet data connection, for processing in the network element, and

15 - means for detecting, based on said distribution decisions, in received data packets sixth data packets, a sixth data packet being a data packet relating to said cluster network address but neither a data packet relating to a packet data connection on said list or on said second list nor a data packet initiating opening of a packet data connection, to be processed in said at least second network element, wherein

20 - said list and said second list comprise timing information for determining how long an opened packet data connection is valid,

25 - said means for maintaining said list is arranged to add a packet data connection relating to a first data packet or a fifth data packet to said list; update timing information in said list, when a second data packet is selected; and remove an opened packet data connection from said list, when a predefined time period from the arrival of the latest data packet relating to said packet data connection is exceeded, and

30 - said means for maintaining said second list are arranged to add a packet data connection relating to a third data packet or a sixth data packet to said second list; update timing information in said second list, when a fourth data packet is detected; and remove an opened packet data connection from said second list, when a predefined time period from the arrival of the latest data packet relating to said packet data connection is exceeded.

35 31. A network element according to claim 30, wherein said list and said second list comprise entries corresponding to opened packet data connections and said means for maintaining said list is arranged to

- add an entry representing an opened packet data connection to said list when a first data packet or a fifth data packet is selected for processing in the network element,
- update said timing information at least when a second data packet is selected, and
- remove an entry from said list, when a predefined time period from the arrival of

5 the latest data packet relating to said entry is exceeded,
and said means for maintaining said second list is arranged to

- add an entry representing an opened packet data connection to said second list when a third data packet or a sixth data packet is detected,
- update said timing information at least when a fourth data packet is detected, and
- 10 - remove an entry from said second list, when a predefined time period from the arrival of the latest data packet relating to said entry is exceeded.

32. A network element according to claim 30, further comprising means for determining the status of an opened packet data connection, wherein entries of said list and said second list comprise status information, said means for maintaining

15 said list is arranged to update said status information according to a determined status and said means for maintaining said second list is arranged to update said status information according to a determined status.

33. A network element according to claim 32, wherein said predefined time period is status specific.

20 34. A network element cluster comprising a plurality of network element nodes, said cluster having a cluster network address common to said plurality of network element nodes and each network element comprising:

- means for receiving data packets,
- means for determining distribution decisions for at least some of received data
- 25 packets according to predetermined criteria,
- means for selecting, based on distribution decisions, from those received data packets, which are data packets initiating opening of packet data connection to said cluster network address, first data packets for processing in the network element,
- means for maintaining a list about opened packet data connections in the network
- 30 element, and
- means for selecting, based on said list, from received data packets second data packets, a second data packet being a data packet relating to an opened connection on said list, for processing in the network element.

35 35. A computer program component for a network element, said network element being a network element for constructing a cluster of network element nodes, said

cluster having a plurality of network element nodes and a cluster network address common to said plurality of network element nodes, said computer program component comprising programs code means for:

- receiving data packets from an operating system,
 - 5 - determining distribution decisions for at least some of received data packets,
 - selecting according to said distribution decisions from those received data packets, which initiate opening of packet data connection to said cluster network address , first data packets,
 - maintaining a list about opened packet data connections based at least on said first
 - 10 data packets,
 - selecting, based on said list, from received data packets second data packets, which are data packets relating to opened connections on said list, . and
 - delivering selected data packets to a second computer program component for processing.
- 15 36. A computer program product comprising program code means stored on a computer readable medium for performing the steps of:
- receiving data packets from an operating system,
 - determining distribution decisions for at least some of received data packets,
 - selecting, according to said distribution decisions, from those received data
 - 20 packets, which initiate opening of packet data connection to said cluster network address , first data packets,
 - maintaining a list about opened packet data connections based at least on said first data packets,
 - selecting, based on said list, from received data packets second data packets,
 - 25 which are data packets relating to opened connections on said list, and
 - delivering selected data packets to a second computer program component for processing,
- when said program product is run on a computer.

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